

Village Power Optimization Model for Renewables (ViPOR)

by Tom Lambert 4/00

Background

High costs and difficult terrain often make it uneconomical to meet small potential loads in many unelectrified regions of the world with an extension from a central utility grid. For these cases, it may be more cost-effective to meet these loads by combining a diesel- or hybrid renewable-powered mini-grid with individual systems, such as solar home systems. The National Renewable Energy Laboratory's (NREL's) *ViPOR* computer model provides the optimal combination of these systems. Given a map of a village and some information about load sizes, available resources, equipment costs, and proposed costs, *ViPOR* equates which loads should be powered by isolated power systems and which should be included in a centralized distribution grid to provide an optimal design that considers local terrain.

Inputs

ViPOR's village representation includes the location of each load point (houses, community centers, stores, etc.), the location of any terrain features (such as roads, rivers, or forested areas) that would affect the cost of running electrical lines, and the potential locations for a centralized power system. For each load point, the expected electrical demand is specified separately for the on-grid case (connected to the centralized grid) and the off-grid case (powered by an isolated system). Potential centralized power system locations can have different generation costs, which can account for different resource options at different locations. NREL's other village power computer model, *HOMER*, calculates these generation costs.

Outputs

ViPOR's optimization procedure searches for the configuration that maximizes lifecycle revenue minus lifecycle costs. The principal output is an optimal configuration map, an example of which is shown on the following page. Other outputs include a breakdown of costs and revenues and a costs versus grid load graph.

Status

A pre-release version of the model is now available for download from NREL's *ViPOR* Web site at <http://www.nrel.gov/international/vipor>. This evaluation version of *ViPOR* ceases to operate after 60 days. Analysis using *ViPOR* is still performed by NREL on a case-by-case basis.

Planned Activities

Planned improvements to the *ViPOR* model include explicit calculation of voltage drops at each node in the distribution system, consideration of several wire and transformer sizes, and tighter integration with *HOMER*.

NREL Contacts

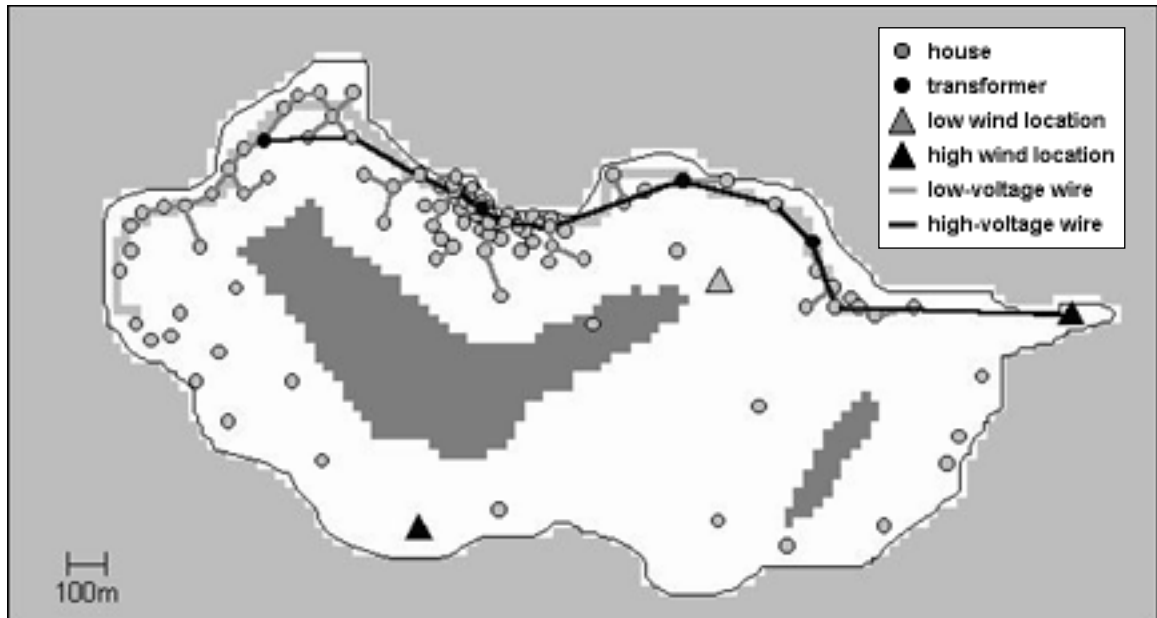
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In this example of ViPORA's output map of a small island village, ViPORA included about 80% of the houses in a centralized distribution grid supplied by a wind/diesel system. The remaining houses are supplied by solar home systems. The distribution system follows the road wherever possible to avoid more difficult, and therefore expensive, terrain. Because the wind/diesel system requires a high-wind location, it had to be located farther from the center of population, which is a low-wind location.